



# Status of CDF luminosity measurements

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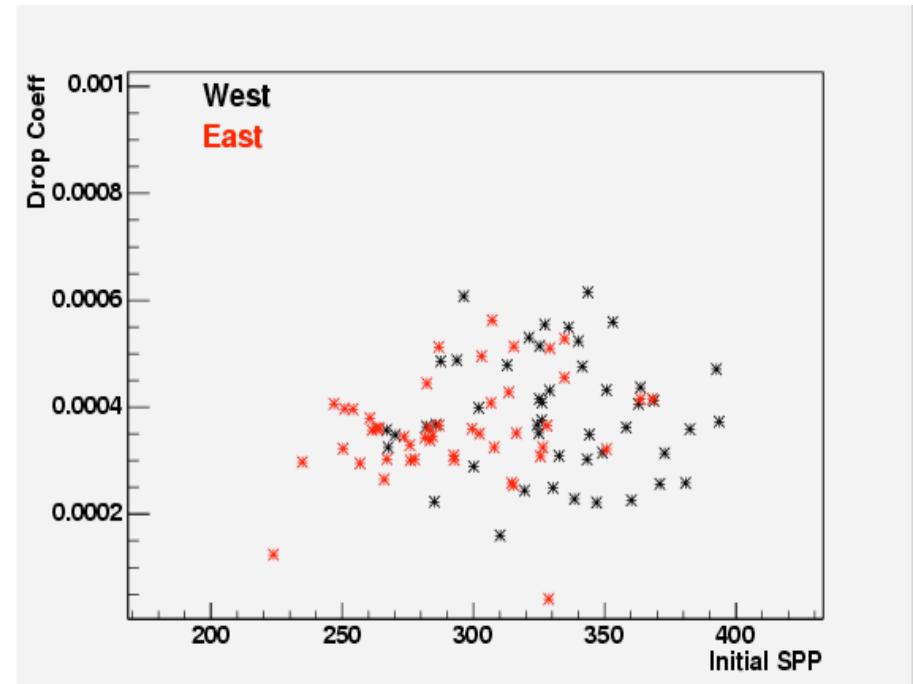
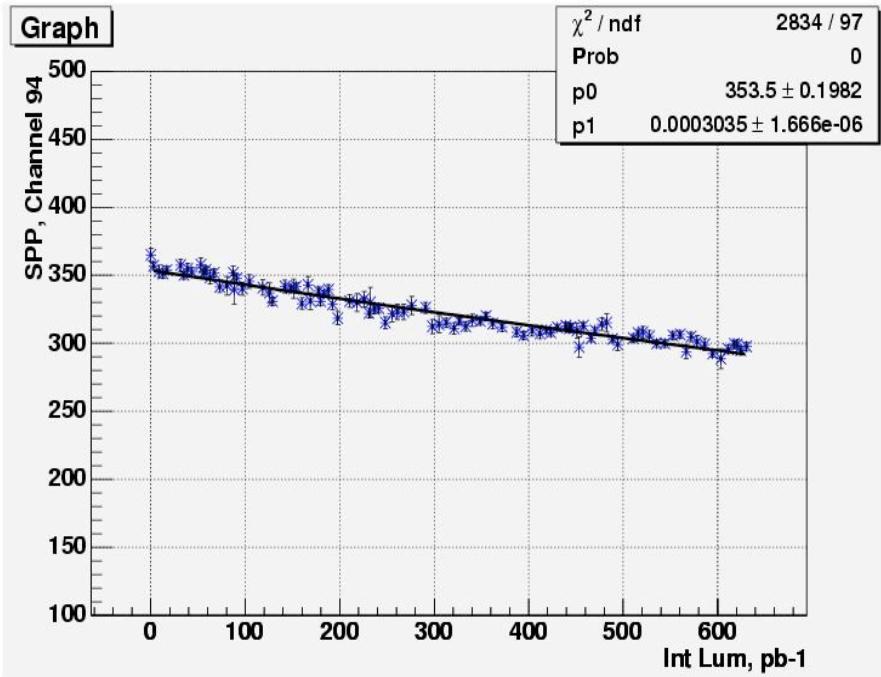
# Outline



- PMT's aging
- COT currents vs luminosity xcheck
- 1 layer measurement



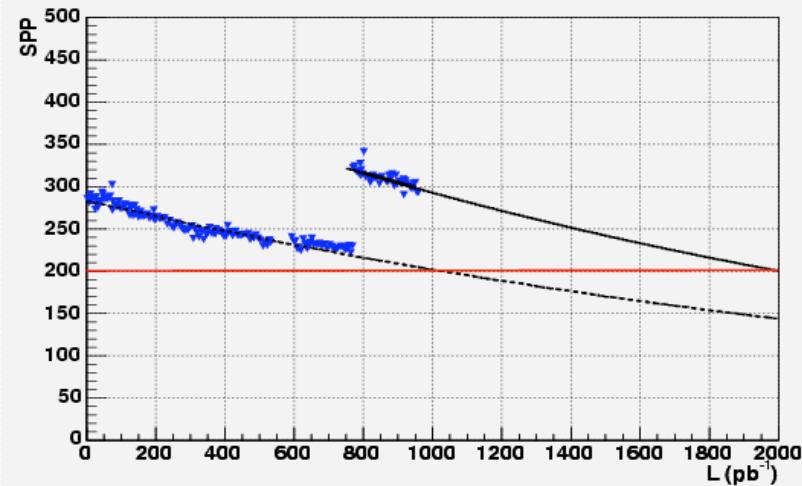
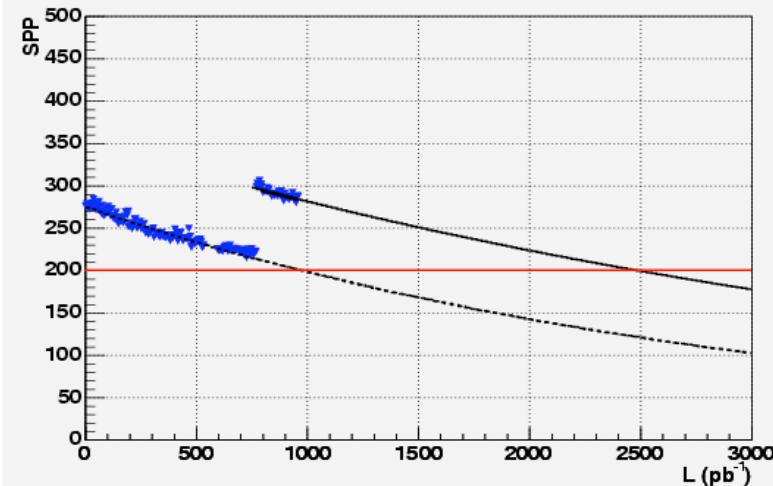
# PMT's aging



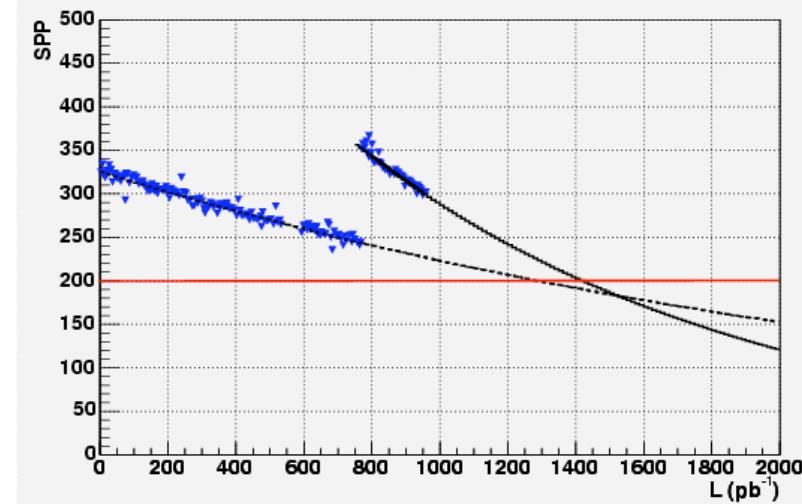
- Fit function:  $p_0 \exp(-p_1 L)$
- $p_0$  - initial SPP value,  $p_1$  - slope
- Average slope is  $\sim 0.04\%$  per pb<sup>-1</sup>  $\Rightarrow 40\%$  per 1 fb<sup>-1</sup>
- Aging rate is in perfect agreement with Hamamatsu specifications: 30-80% per fb<sup>-1</sup>



# Gain in PMT's lifetime



- By increasing the HV on some of the channels, we can gain  $\sim 1\text{fb}^{-1}$  in PMT's lifetime
  - These plots: 50V, inner layers
- Does not work for all of the channels, especially for old ones





# COT vs CLC - Idea



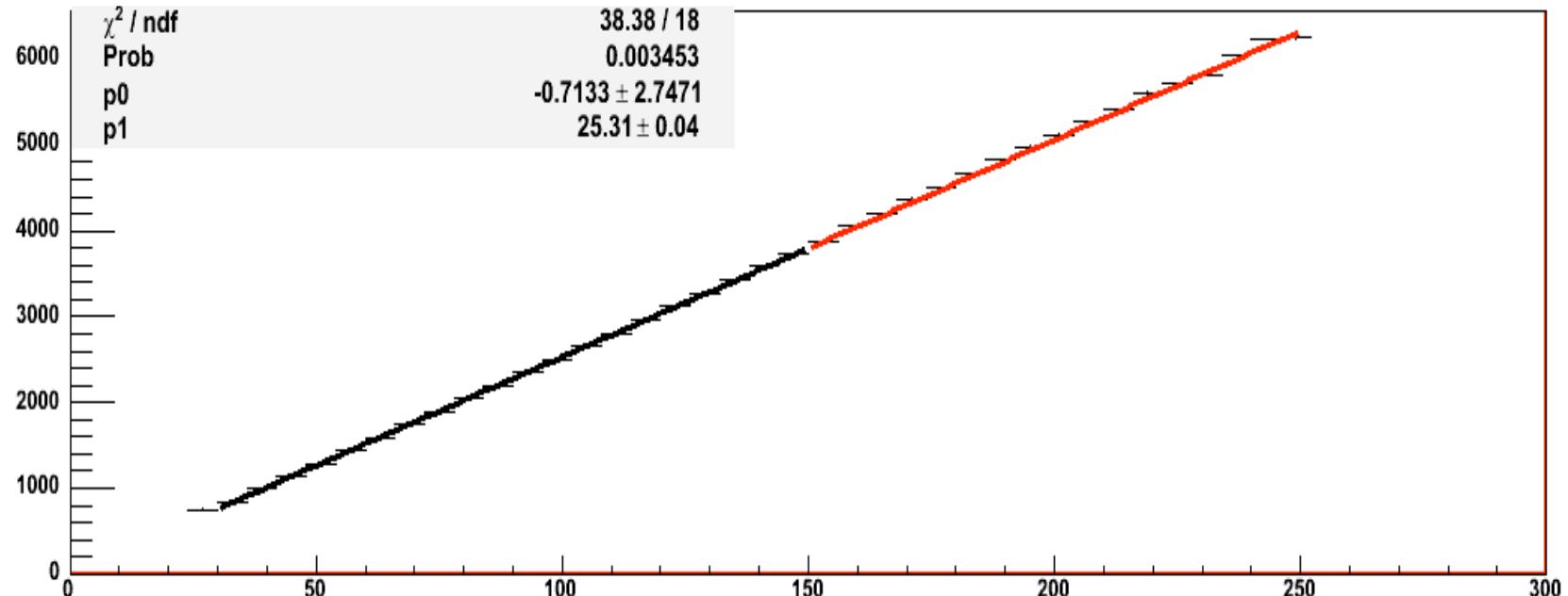
- Central Outer Tracker (COT) in CDF is a drift chamber, with 8 super layers(SL), covering radii between 44cm and 132cm.
- **If there is no saturation on currents, we expect the currents to scale linearly with luminosity.**
- We checked the COT currents by comparing  $SL_i$  VS  $SL_j$ . Only first 2 SL's showed saturation effects.
- **Results we are showing are based on  $SL_8$ . The outermost layer.**



# COT vs CLC - Result



SuperLayer\_8\_Cot\_vs\_Lumi



Here we plot:

SL8 VS B0lum

X axes -> Lum[E30cm-2s-1]

Y axes -> SL8 current

Fit(black) up to 150E30.

Extrapolated(red) to guide the eye.

Data collected in February 2007

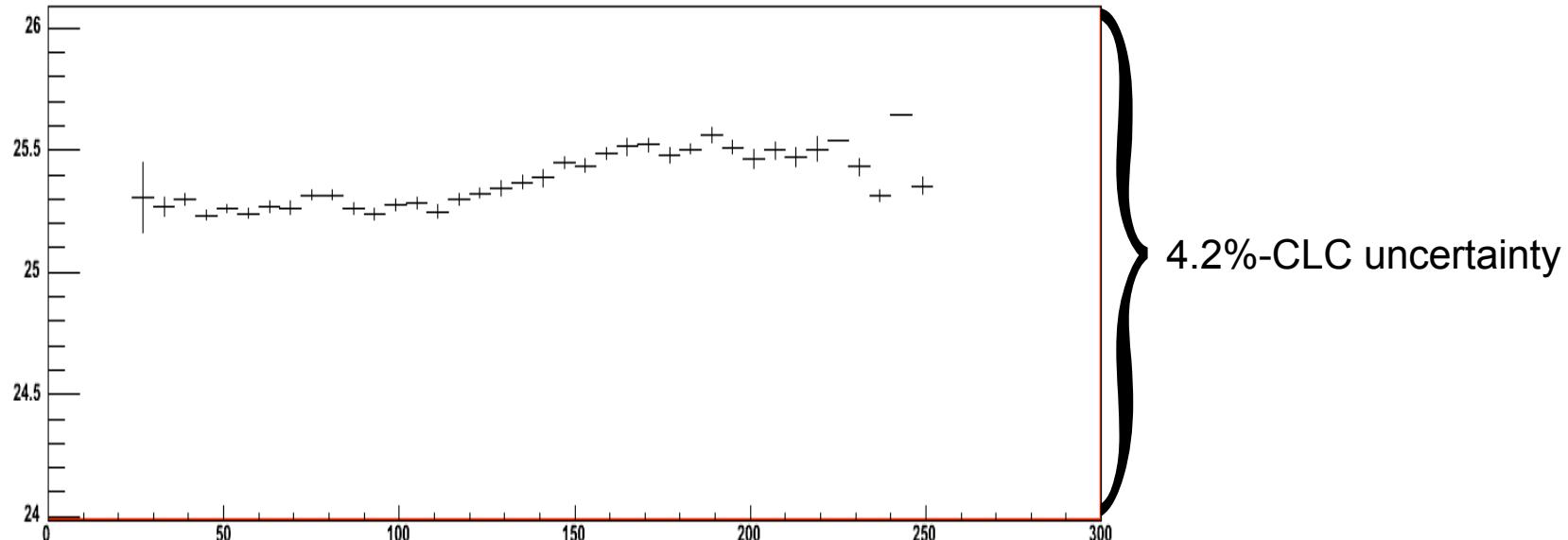
Period contains the record store 5245  
and few other stores with Lumi>280E30



# COT vs CLC - Result



SuperLayer\_8Cot2Lumi\_vs\_Lumi



Here we plot:

SL8/B0lum VS B0lum

X axes -> Lum[E30cm-2s-1]

Y axes -> SL8/Lum.

Full range is 4.2%. CLC uncertainty

Data collected in February 2007



# CLC basics



$$L = \frac{\mu f_{BC}}{\sigma_{in}}$$

- Methods to estimate average number of interations per BC -  $\mu$ 
  - Counting number of empty crossings - current method. Probability of empty crossings:  $P_0 = N_0/N_{BC}$ . Naively:  $P_0 = e^{-\mu}$ , but in reality need to take into account detector acceptance:  $P_0 = (\exp(\mu\varepsilon_W) + \exp(\mu\varepsilon_E) - 1)\exp(\mu\varepsilon_O - \mu)$
  - Other methods
    - Counting of hits
    - Counting of particles
- So, basically for each measurement we need to calculate number of zero crossings -  $N_0$
- Obvious disadvantage of this method is that at high luminosities, we can reach saturation in measuring  $N_0$



# 1 Layer measurement



- $N_{BC}=20,000$ (HW limit)
- Cutoff on  $N_0 < 4$ 
  - $P_0 < 2 \times 10^{-4}$
  - $L > 360 \times 10^{30} - 2L$
  - $L > 430 \times 10^{30} - 1L$
- In reality, bunches are not equal
  - Highest luminosity bunch can have 20-30% higher luminosity
- Real life cutoff
  - $L > 280 \times 10^{30} - 2L$
  - $L > 340 \times 10^{30} - 1L$
- The idea:
  - Switch to 1 layer measurement for  $N_0(2L) < 4$
  - Apply the correction factor 0.96.
  - Does not affect the measurement up to  $\sim 280 \times 10^{30}$
  - Safe limit for this method is up to  $340 \times 10^{30}$
  - Overall effect on luminosity expected to be small

